

MEMORANDUM FOR: Ronnie L. Taylor  
NOS Advisor, Florida

FROM: Charles W. Challstrom  
Acting Director, National Geodetic Survey

SUBJECT: INSTRUCTIONS: FLORIDA FBN/CBN, 1999 PHASE I (GPS- 1378)

**GENERAL:**

The National Geodetic Survey (NGS), in accordance with the NGS Strategic Plan, is engaging in a campaign of re-observing stations of the Federal Base Network (FBN) and Cooperative Base Network (CBN) to complete the ellipsoidal and orthometric height components of the FBN/CBN. This survey will observe the 44 FBN stations and several CBN stations in the state of Florida. This is the first of two or three campaigns to re-observe the entire FBN/CBN network in Florida. This campaign will be continuous and will tie into the adjoining states.

Tidal Bench Marks at 18 tide stations along the Atlantic and Gulf coast will also be surveyed during this project. Occupations of these Tidal Bench Marks must meet **FBN** specifications for this project (height modernization). The 18 tide stations are: Key West, Vaca Key, Key Colony beach, Virginia Key, Trident Pier, St. Augustine Beach, Mayport, Fernandina Beach, Naples, Ft Myers, St. Petersburg, Clearwater Beach, Cedar Key, Turkey Point, Apalachicola, Panama City, Panama City beach, and Pensacola.

In addition, at each of CORS site in Key West, Miami, and Cape Canaveral, a pair of CORS reference marks is to be connected to both the local FBN and the CORS antenna. Pertinent information for observing these sites are given under SPECIFICATIONS.

A Full - wavelength, dual-frequency Global Positioning System (GPS) receiver is need to act as a Central Temporary CORS (CTCORS) where there are no existing CORS within 150 km of the ongoing observations. The receiver shall be deployed at a relatively secure station within the vicinity of the ongoing observing sessions. The receiver shall continuously collect data at a 30-second (15 second if desired) epoch collection interval for 72 hours or more before being broken down. A CTCORS must be deployed even if there is an existing CORS within 150 km of ongoing observation, at a relatively secure station and collect data for 72 hours or more.

Mr. Ronnie L. Taylor, the Florida State Geodetic Advisor, is coordinating the co-observing by various organizations of approximately 100 FBN's and CBN's. This project will be performed under the technical management of NGS.

**PURPOSE:**

In order to meet America's accelerating positioning and navigation needs, the existing coordinate reference system must be continually enhanced to provide the accessibility and high accuracy required for use with GPS. The digital revolution in mapping, charting, and surveying requires a National Spatial Reference System (NSRS) consisting of, among other components, a network of monumented points having four-dimensional positions. FBN fulfills the requirements for this component. NGS is charged with the Federal responsibility for establishment, observation, monitoring, and maintenance of the FBN. The FBN provides the critical network foundation for an accurate, consistent, and reliable NSRS. The CBN fulfills the requirements of the state.

The NSRS, in turn, provides the common geographic framework for America's spatial data infrastructure. As such, NSRS serves as the basis for mapping, charting, navigation, boundary determination, property delineation, infrastructure development, resource evaluation surveys, and scientific applications, including crustal motion monitoring, modeling of flooding, storm surge, pollution trajectories, and agricultural runoff. A modernized, accurate, consistent, reliable NSRS is of enormous benefit to state, county, tribal, local, and Federal authorities, as well as to the private sector.

The tide site (height modernization) surveys will provide GPS-derived ellipsoid heights, accurate to 2 cm, on tide stations water-level monuments along the east and West Coast of Florida.

The reference marks established at each of the CORS sites will provide a very accurate tie to each antenna, as an aid to repositioning the antennae should that become necessary. The FBN/CBN ties to the CORS monuments will also provide site station coordinates relative to the local FBN/CBN, thus reducing the potential for relative error between the stations and the local network. It will also provide a check on the FBN/CBN, relative to the CORS coordinates.

#### **SPECIFICATIONS:**

Project requirements for the FBN/CBN observations are to ensure 2-centimeter local accuracy in the horizontal component, as well as 2-centimeter local accuracy for the ellipsoid heights.

Data from the CORS in the region are to be used in the processing. The following is a list of the CORS that should be used: EKY1, COV3, AOML, MIA3, KYW1, MOB1, MCN1, AND CHA1 OR IF ON LINE SAV1. Positions and data are available from the NGS web site. Due to the distance between the CORS in the state, CTCORS should be established at approximately 150 km spacing throughout the state.

**General specifications for the project are as follows.** At each FBN/CBN station, three (3) sessions of 5 1/2 hours duration shall be observed. The observing scheme shall be arranged so that for each station, the start time of one of the observing scheme shall be at least 4 hours different than the other two. The observing scheme shall be arranged to ensure that adjacent FBN/CBN stations are directly connected in at least one observing session, and at least half of all base lines are repeated.

Specific to the four (4) CORS sites is that for the two (2) reference stations at each site shall be observed for the entire 5 1/2 hours. Specific to the two (2) WAAS sites is that for the two (2) reference stations at each site shall be observed for the entire 5 1/2 hours. Following is the list of names of the CORS sites, their reference marks, and their FBN/CBN ties:

In general, station occupation and observing procedures must be carried out according to appropriate sections of the "NGS Operations Handbook" and the current applicable receiver field manuals. Data formats and digital file definitions are given in "Inputs Formats and Specifications of the National Geodetic Survey Data Base," Volume I. Horizontal Control Data, Federal Geodetic Control Subcommittee, September 1994, revised November, 1998. Success in meeting the accuracy standards will be based on repeatability of measurements, analysis of loop misclosures, and adjustment residuals.

General specifications for the project are given in "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques," Version 5.0: dated May 11, 1988, reprinted with corrections August 1, 1989. Specific project criteria and deviations from the general specifications are given in the following sections.

**Project Network** - A list (Table 1) and sketch of stations will be provided.

**Data Acquisition** - Data collection must be accomplished as specified in the appropriate dual-frequency receiver field manuals in the compressed mode at a 15-second epoch collection interval. The GPS receivers must be dual - frequency and full - wavelength. Track satellites down to a 10 - degree elevation angle. Set minimum number of satellites to one (1).

The satellite-observing scenario has been provided in Table 2. (Sessions will generally begin at three observing windows at least 4 hours apart - 1200 UTC (March 03) Local 7:00 am March 3, 0300 UTC (March 04) local 10:00 PM March 3, and 1700 UTC (March 04) local 12:00 PM (noon) March 04. Vectors between the project stations shall be measured by single sessions consisting of continuously and simultaneously tracking for 5 1/2 hours.

Each FBN/CBN station will be occupied three times at three different observing windows. Each FBN/CBN station has conventional orthometric heights established on them or will be tied to existing vertical control. The CORS base lines will be repeated. CORS and CTCORS data will be used throughout the project. All CORS and CTCORS will be collecting data at minimal of 72 hours, beginning at 2300 UTC (local time 6:00 PM) on March 2, 1999 and ending at 2300 UTC (local time 6:00 PM) on March 5, 1999.

Record weather data just before, immediately after, and at the mid-point of each session. Meteorological data shall also be collected immediately after an obvious weather front passes during a session and immediately before it passes, if possible. Pressure and relative humidity measurements must be made near and at about the height of the GPS antenna phase center. Indicate in the log the location of the barometer and psychrometer.

Survey operations shall be conducted with due regard to the safety of personnel and equipment. Contact with the airport traffic control tower is mandatory during surveys at any controlled airports.

**Vector Computations** - Data Management, quality review of collected data, and final vector processing for the FBN/CBN survey will be accomplished by the NGS Geosciences Research Division Using PAGES.

The CORS and CTCORS available in the project area will be used as the basic network for the processing. Fixed base lines between 24 - hour CORS and CTCORS will be designated to maximize the effect of the continuously operating stations. Typically one CORS will be centrally constrained hub from which vectors to other CORS and CTCORS will be computed. In areas where CORS are located close together, the network scheme will have to be decided on a case by case basis. The CORS and CTCORS will be designated as the hub sites for each project.

Vectors shall be computed in the International Terrestrial Reference Frame (ITRF) system, using the most current epoch and precise IGS ephemerides. 30 - second epoch intervals will be used for data processing. Predicted meteorological data will be used for PAGES processing. Use 15 degrees as the cutoff elevation angle in data processing. A cutoff angle of 10 degrees may be used when necessary to improve results.

The type of final solution, L1 versus ion-free, will depend on the length of the vectors. For vectors, which are less than 10 km in length, the final reduction will consist of a L1 fixed solution. These vectors will be computed in a separate processing session from the longer vectors computed in an ion-free solution.

In general, vectors greater than 10 km in length are to be computed in an ion-free fixed, or partially fixed, solution. In all cases, integer ambiguities will be fixed for each vector whenever possible.

For each set of CORS reference marks, the CORS antenna at the site will be used as the reference station in the data processing.

The quality of collected data shall be determined from the plots generated from PAGES, by analysis of repeated vectors and/or comparison of station positions, and free adjustment residuals and/or loop misclosures.

The Spatial Reference System Division will perform all quality checks for conformance with NGS format standards such as executing software programs COMPGB, OBSCHK, and OBSDES. The final ITRF vectors will be assessed and transformed to the NAD83 coordinate system-using program ADJUST. A constrained adjustment in the NAD83 coordinate system holding all CORS and CTCORS positions fixed is required.

The data and results will be submitted to the Observation and Analysis Division. All B-files and G-files must be complete, including \*25\* and \*27\* records.

**Station Descriptions** - Station recovery notes must be submitted in computer-readable form using DDPROC software. Include the name, address, and telephone number of a property owner or other contact.

**Special Requirements** - Antenna set-up is critical to the success of this project. Fixed-height tripods are preferred for all receivers. The plumbing bubbles on the antenna pole of the fixed-height tripod must be shaded when plumbing is performed. They must be shaded for 3 minutes before checking and/or replumbing. Also, the perpendicularity of the poles must be checked at the beginning of the project and any other time there is suspicion of a problem.

When a fixed-height tripod is not used, the height of the antenna must be carefully measured to prevent station set-up blunders from occurring. Tribrachs used for these set-ups must be checked and adjusted when necessary. Totally independent measurements of the antenna height above the mark in both metric and English units must be made before and after each session. Someone other than the observer must check the measurement computations by carefully comparing measurements and then entering his/her initials on the log.

A rubbing of the stamping of the mark must be made at each visit to a station. If it is impossible to make a rubbing of the mark, a plan sketch of the mark must be substituted, accurately recording all markings.

For each station visited, a visibility obstruction diagram must be prepared and the TO-REACH description carefully checked for errors or omissions.

The following must be recorded at each occupation of a station:

- (1) receiver manufacturer,
- (2) antenna manufacturer,
- (3) receiver model number (part number),
- (4) antenna model number (part number),
- (5) the complete serial number of the receiver, and
- (6) the complete serial number of the antenna.

**Success of this project requires that the highest quality GPS data be collected. Therefore, during each station occupation, the operators shall carefully monitor the operation of the receivers. Any irregularities in the data due to equipment malfunction, DOD adjustment of the satellite orbit, obstructions, etc., must be reported to the Field Operations Branch, N/NGS41, as soon as possible and noted on the observing log. If the quality of observations for an observing session is questionable, notify the Field Operations Branch immediately.**

The survey team shall not depart the project area until they have quality reviewed all data, advised N/NGS21, and notified N/NGS41.

#### **GPS DATA:**

Visibility tables and plots of the present satellite constellation for March 3, 1999, have been reviewed and three observing windows selected. For operational use, current data must be generated with Trimble mission planning software or from program SATMAP.

Project report and data listed in Annex L of "Input Formats and Specifications of the NGS Data Base" and in the attached addendum for the adjustment portion must be transmitted. Any data considered suspect as to quality in achieving accuracy standards should be sent via FedEx immediately for office review. **Backup of transmitted data must be held until notified by the Field Operations Branch, N/NGS41.**

The data set collected during the project shall be copied to a directory named as an example "FLROA99062". **This naming represents the 4 digit character ID; A = FIRST SESSION OF DAY; 99 = the year; and the 062 is the Julian date.** Each file shall be named as follows; **firo062a.met** or whatever the extension is. **The firo is the 4 character ID; the 062 is the Julian date; and the A is the session. Note: on March 03 you will have two (2) sessions so they will be A and B.** All records in connection with this project shall be titled "FLORIDA FBN/CBN, 1999". The project number (accession number) is GPS-1378.

**LIAISON:**

Liaison must be maintained with designated offices at the National Geodetic Survey headquarters located at:

1315 East-West Highway  
Silver Spring, Maryland 20910-3282

Questions and problems concerning survey field operations should be directed to:

William T. McLemore, Jr.  
Chief, Field Operations Branch  
Observation and Analysis Division  
N/NGS41, SSMC III, Station 8564  
Telephone: 301-713-3215, ext. 117  
Fax: 301-713-4327  
e-mail: [mclemore@ngs.noaa.gov](mailto:mclemore@ngs.noaa.gov)

Questions and problems concerning adjustment processing should be directed to:

Maralyn L. Vorhauer  
Observation and Analysis Division  
N/NGS4, SSMC III, Station 8562  
Telephone: 301-713-4327, ext. 104  
Fax: 301-713-4327  
e-mail: [maralyn@ngs.noaa.gov](mailto:maralyn@ngs.noaa.gov)

Questions and problems concerning vector processing should be directed to:

Juliana Blackwell  
Field Operations Branch  
Observation and Analysis Division  
N/NGS41, SSMC III, Station 8458  
Telephone: 301-713-3215, ext. 108  
Fax: 301-713-4327  
e-mail: [juliana@ngs.noaa.gov](mailto:juliana@ngs.noaa.gov)

Questions and problems concerning using CORS data in processing should be directed to:

Neil Weston  
Geosciences Research Division  
N/NGS6, SSMC III, Station 9830  
Telephone: 301-713-2847, ext 202  
Fax: 301-713-4327  
e-mail: [nweston@ngs.noaa.gov](mailto:nweston@ngs.noaa.gov)

Questions and problems, which could affect the technical adequacy of the project, should be directed to:

Stephen J. Frakes (Douglas Hendrickson)  
Chief, Project Development Branch  
Spatial Reference System Division  
N/NGS21, SSMC III, Station 8853  
Telephone: 301-713-3194, ext.111 (ext. 127)  
Fax: 301-713-4316  
e-mail: [steve@ngs.noaa.gov](mailto:steve@ngs.noaa.gov) ([dough@ngs.noaa.gov](mailto:dough@ngs.noaa.gov))

The contact for the project is:

Ronnie L. Taylor  
NOS Advisor, Florida  
3900 Commonwealth Blvd., MS105  
Tallahassee, Florida 32399  
Telephone: 850-488-2427, ext. 1212  
Fax: 850-413-9001  
e-mail: taylor\_rl@dep.state.fl.us  
**Pager: (850)531-4083**

For tide site information, contact:

Thomas Landon  
Requirements and Development Division  
SSMC4/Station 6409  
1305 East-West Highway  
Silver Spring, Maryland 20910-3282  
Telephone: 301-713-2897, ext. 191  
Fax: 301-713-4435  
e-mail: thomas.landon@noaa.gov

Names and telephone numbers of local contacts are given in the station description material.

**ADDRESS:**

Keep N/NGS41 informed of any changes in your address, physical address, and telephone number and pager number at all times.

**PUBLICITY:**

See "NGS Operations Handbook," Section 1.4.1.

**EXPENSES:**

All FedEx cost will be charged to task number.

**TRAVEL:**

Travel and per diem are authorized in accordance with Federal Travel Regulations, Part 301-7, Per Diem Allowances. Current per diem rates were effective January 1, 1999.

**ACKNOWLEDGMENT:**

Please acknowledge receipt of these instructions in your Monthly Report.

Attachment

cc: N/CS - N. Prah  
N/CS41 - T. Landon  
N/NGS - D. Zilkoski  
N/NGS - S. Misenheimer\*  
N/NGS1 - G. Mitchell  
N/NGS1x1 - R. Taylor  
N/NGS11 - S. Cofer  
N/NGS2 - J. Till  
N/NGS21 - S. Frakes  
N/NGS21 - D. Hendrickson\*  
N/NGS22 - T. Soler  
N/NGS3 - E. Allen  
N/NGS4 - E. Wade  
N/NGS4 - M. Vorhauer  
N/NGS4 - D. Hoar  
N/NGS41 - W. McLemore  
N/NGS41 - J. Blackwell  
N/NGS5 - R. Snay  
N/NGS6 - N. Weston  
FGCS Members\*

\* First page only

**DATA TO BE SENT TO HEADQUARTERS RELATING TO THE  
FBN/CBN RE-OBSERVATION IN FLORIDA**

**NOTE:** All observation log sheets, visibility charts, observation rubbing sheets, description sheets, etc. are to be completely filled out and sent to the Coordinator.

The following information must be submitted to the Coordinator.

- Observation log sheets (1 each for each session)
- Visibility chart
- Observation rubbing sheet (1 each for each session)
- Description sheet
- Raw data file (1 each for each session)
- RINEX data file (1 each for each session)

Please make any notes on the Observation log sheet that will let the data processors know if anything happen, problems encountered, down time, height problems, etc. Information such as this is critical. Remember the heights of these antennas's are critical to obtain good ellipsoidal heights.